Muon Tracking System at KamLAND

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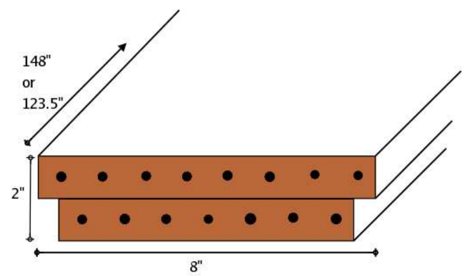

FIG. 1: Diagram of a Module.

KamLAND detects anti-neutrinos from nuclear reactors by looking for the delayed coincidence signal from the interaction of a anti-neutrino with a proton. This interaction creates a prompt positron annihilation signal followed by a neutron capture signal $200\mu S$ later. The largest background to this signal is neutrons produced by muon spallation which can create accidental delayed coincidence pairs. There are also light elements produced by muon spallation whose decay can mimic a anti-neutrino delayed coincidence signal most important of these being ^{9}Li and ^{8}He. Once these events are removed from the dataset, they are used along with ^{12}B and ^{12}N to check KamLAND's energy reconstruction. However, before spallation products can be removed from the dataset and utilized for other studies the parent muon must be detected and reconstructed.

KamLAND's geometry is perfect for reconstructing point like events. Muons are more difficult to reconstruct since they deposit light along a path through the detector and they produce at least an order of magnitude more light. Since reconstructing muons is so important to removing backgrounds and understanding the data, construction of a separate system to track a subset of muons entering KamLAND has begun. This external muon tracker is composed of scintillator paddles for triggering and proportional tubes for position reconstruction. These components were built for a fixed target experiment and are being refurbished for the muon tracker.

There are 53 proportional tube modules. Each module contains fifteen 1" x 1" x 123" or 148" tubes arranged in 1 layer of 8 above 1 layer of 7 which creates a 1/2" space between wires, figure 1. The modules can be arranged into two 3m x 3m squares each containing two layers of modules perpendicular to each other. The modules can also be arranged into three 2mx3m rectangles each containing two layers of modules at 30^o to each other, figure 2. Such configurations would see several hundred muons in coincidence with the detector per day and constrain the track to several cms. The first arrangement would give you the largest area and most accurate determination of the x and y position of the track but would not allow you to check the efficiency of each segment.

The detector is being refurbished in building 60. We are in the process of repairing 32 modules that need at least 1 channel repaired and preparing to re-wrap and test the scintillator paddles. A prototype front-end electronics board has started being tested and CAMAC logic units interfaced with the MIDAS DAQ software have been setup to acquire data initially. In the future there are plans to build a VME interface to the front-end electronics. Incorporating this data into the data stream and building the support structure are the outstanding issues. We plan to finish testing the setup here at LBNL and have the apparatus in Japan by the end of the summer.

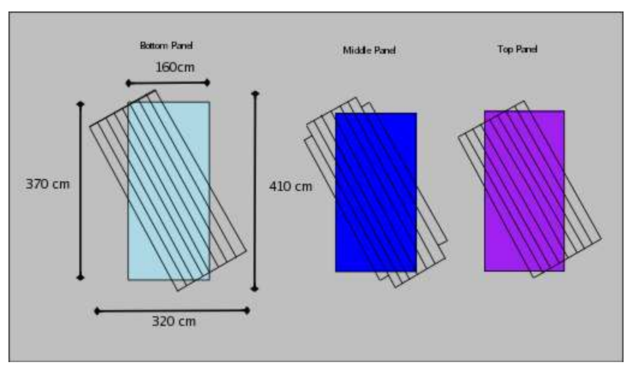

FIG. 2: Diagram of Three Panel Arrangement (panels will be placed on top of each other separated by 1m).